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Japanese raspberry (Rubus parvifolius L.): An invasive species threat in savanna and prairie

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JAPANESE RASPBERRY (*Rubus parvifolius* L.): AN INVASIVE SPECIES THREAT IN SAVANNA AND PRAIRIE

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Abstract: Japanese raspberry (*Rubus parvifolius* L.) is native to eastern Asia and Australia and has naturalized in several locations in Illinois, Iowa, Massachusetts, Missouri, and Ohio. This species was introduced in North America for food and erosion control, but it appears to be becoming a serious invasive species threat in savannas and prairies. It was found in a former commercial game-hunting farm on Walnut Creek National Wildlife Refuge (now Neal Smith National Wildlife Refuge) in 1991, and was identified as Japanese raspberry in 1995. Japanese raspberry grows vigorously and spreads via rooting from low-arching-to-prostrate canes that are up to 300 cm long, and its seeds can be dispersed by birds. In summer, primocanes are green to purplish green, though they turn reddish brown in winter. It has small pink flowers and bright red fruits. It thrives in shade in a remnant savanna on the refuge, forming rapidly expanding near-monoculture populations. Efforts to control it with herbicide treatment since its discovery have been unsuccessful, but also somewhat sporadic. A second population in a roadside within a mile of the refuge demonstrates its ability to thrive in full sun. County dredging of ditches for drainage improvement may be serving as a vector for its expansion.

Keywords / Search Terms: bramble, naturalization, roadsides, trailing raspberry

JAPANESE RASPBERRY AN INVASIVE SPECIES

In 1991, I (Pauline Drobney) and a colleague, Scott Bryant, were contracted to develop a flora of the proposed Walnut Creek National Wildlife Refuge, now Neal Smith National Wildlife Refuge (Neal Smith NWR). An unusual bramble was found growing within the dripline of a large oak in a degraded savanna in Jasper County, Iowa, being used as a game farm. The plant was densely matted and weakly prickled, and it virtually excluded other vegetation. Initial attempts to positively identify it to species failed. In June of 1995, my coauthor, Mark Widrlechner, identified the species as *Rubus parvifolius*, the Japanese, or trailing, raspberry (Widrlechner 1998).

Difficulty in identification was understandable, given that this species was absent in nearly all North American botanical manuals. Widrlechner noted that the refuge had the dubious distinction of having the largest population he had seen to date.

Japanese raspberry was found in Iowa in 1988 in a roadside bordering the North Central Regional Plant Introduction Station (NCRPIS) farm, southwest of Ames. Widrlechner supposed it had persisted as a result of a past cultivation project, but began to notice it in various other locations in the Ames area, with one population in an Ames woodland spread over about one-half acre. He began an investigation to discover the path of its introduction to Iowa.

A search of all accession records at the NCRPIS failed to yield any evidence of its cultivation there, strongly suggesting that its appearance in Iowa likely predated the founding of the NCRPIS in 1948 (Widrlechner and Rabeler 1991). Notably, Japanese raspberry had apparently escaped cultivation much earlier in Massachusetts (Rich 1908; Knowlton and Deane 1918). It had been grown at Arnold Arboretum at least since 1915, escaped cultivation, and in 1948 was vouchered as growing on a slope there (Palmer 48417, BH). In 1929, seeds of *R. parvifolius* were collected in Japan by P. H. Dorsett and W. J. Morse of the USDA's Division of Plant Exploration and Introduction (Widrlechner and Rabeler 1991). Because of its large red fruits, coupled with the discovery that it was disease resistant (Williams and Darrow 1940) in Maryland and North Carolina, the species became attractive to breeders interested in fruit production (Widrlechner and Rabeler 1991).

Figure 1. Closeup of Japanese raspberry flowers. Photo by Brian Riley, June 1, 2008.

Its establishment in Iowa, however, was most likely related to a project developed by the USDA's Soil Conservation Service (SCS) to find ways to control erosion on sloping land. A Federal Erosion Nursery and Hill Culture Research Station were established by the SCS in the 1930s on the land that was to become the NCRPIS farm in 1948. An SCS accession book and typewritten inventories for an "introduction area" and other reports from this project indicate that cane fruits, including various species of *Rubus*, were being cultivated and studied in Ames during the 1930s and 1940s for their potential to control erosion. A raspberry breeding program at Iowa State College (now University) also reported growing hybrids involving *R. parvifolius* (Maney 1945). However, there are no specific records indicating that *R. parvifolius* was being grown in the field, either by the SCS or Iowa State College (Widrlechner and Rabeler 1991), leaving its origins in Iowa enshrouded in mystery.

In any case, by the 1960s, this species was being distributed for conservation purposes within Iowa by the Iowa Department of Natural Resources State Forest Nursery in Ames (J. Grebasch, personal communication). These distributions may have led to the occurrence of *R. parvifolius* at the savanna at Neal Smith NWR. In July 2010, I learned that this population had originated in about 1967 or 1968, when propagules were obtained from another shooting preserve near New Sharon, Iowa, because of its interesting and tasty berry (S. DeBruin, personal comm.). For two years after planting, the developing patch was tended, but the owners lost interest in weeding and the patch was abandoned. Steve DeBruin, who grew up on the site, believed that it had been planted in a sunny location, but that when weeding ceased, it became overgrown with grass and, eventually, with trees. It is interesting to note that despite early cultivation and apparent success in growth, the patch did not necessarily persist in the original location, as the observation of it in 1991 was under the dripline of a large, old oak, and thus not in the open sunny position where it began.

Figure 2. Closeup of Japanese raspberry fruits. Photo by Pauline Drobney.

Japanese raspberry is native to Japan, Korea, China, and southeastern Australia (Naruhashi 1987). When in fruit, this species is obviously a raspberry (subgenus Idaeobatus) with clusters of drupelets that can easily be removed from the central receptacle (or torus), forming a juicy red thimble. Compound leaves, whitened beneath, are born on trailing primocanes (first-year stems) that root at the tips and nodes. Small rose-pink flowers bloom on floricanes (second-year stems) from late May to early June in Iowa, with fruit set in late June into July. These characteristics (see Figures 1 and 2) and its distinctive tangled, mounding growth habit make it easily distinguishable from Iowa's native *Rubus* species. (Both *R. parvifolius* and Iowa's native species are described and keyed in Widrlechner (1998). However, its tangled, mounding habit does resemble a different nonnative bramble occasionally found in Iowa, *Rubus caesius* L., the European dewberry (Widrlechner and Wagner 1998). Since 1998, *R. caesius* has been noted at an increasing number of sites in central Iowa, where it may pose another invasive threat, but this is not the focus of our current presentation.

Another rose-pink-blossomed, red-fruited bramble, native to the Midwest (but not Iowa), is R. odoratus, the purple-flowering raspberry, a member of the subgenus *Anaplobatus*. But it would be difficult to confuse it with *R. parvifolius*, since it has upright, unarmed canes, simple leaves, and large showy flowers.

In addition to its occurrence at the NCRPIS and Neal Smith NWR, *R. parvifolius* was first collected in Iowa in 1954 in Cherokee County and later from other sites in Page, Story, and Taylor Counties, as reported by Widrlechner (1998). More recently, it has been collected at Black Hawk Point Wildlife Management Area in Allamakee County (M. J. *Leoschke* 2659, 12 Jun 2007 ISC), along Tunnel Mill Road in Hamilton County (J. D. Thompson s.n., 27 Jun 2002, ISC), at Harmon Lake Wildlife Management Area in Winnebago County (M. J. *Leoschke* 2897, 9 Jun 2010, ISC), at Dewey's Pasture Wildlife Management Area in Palo Alto County (M. J. *Leoschke* 2928, 26 Jul 2010, ISC), and at Elk Creek Marsh State Wildlife Management Area in Worth County (C. Hall s.n., 16 Oct 2001, ISC). In addition to herbarium vouchers, in 2009 Widrlechner received two photographs of this species taken on parkland near Summerset State Park in northern Warren County. Within the Midwest, it has also been found as an escape from cultivation in Illinois (Widrlechner and Rabeler 1991), Missouri, and Ohio.

After discovering the plant at Walnut Creek NWR in 1991, and becoming Refuge Biologist a year later, I periodically observed its status for several years, noting that the population was expanding and seemingly excluding native herbaceous species. Upon learning its identity and status as an exotic species from Widrlechner, I became concerned about its invasive potential.

In fall of 2001, refuge pesticide records indicate that the staff treated this population using a backpack pump and glyphosate, noting that summer treatments at concentrations lower than 7% were ineffective, as was 1% to 2% triclopyr. Five treatment sets (treatment was not always accomplished on a single day) occurred in June, July, August, and early September with treatment intervals ranging from approximately two to five weeks. Treatment was considered successful if green leaves turned brown and seemingly lifeless, and the plant was considered dead.

Revisitation of the Japanese raspberry site in 2006 confirmed a population near the original location, and a second, clearly separate population was discovered within 100 m to the north. However, small isolated patches on the refuge of *Lespedeza cuneata* (Dum.-Cours.) G. Don, commonly known as sericea lespedeza were increasing in size and being found in several new locations at this time. Treatment had not been effective and a rapid and immediate response was required by refuge staff. With this shift of invasive-species control priorities, Japanese raspberry was left unchecked.

In 2006, I observed a cane of Japanese raspberry growing in a recently dredged roadside within 0.1 mile of the former game farm. A robust, dense mat of this species was noted in the same roadside approximately 0.5 mile south of the dredged area, and also existed in terraces within the adjacent crop field. The source of the newly establishing cane in the roadside is uncertain, but it is possible that it was actually a seedling resulting from bird dispersal, or that the cane was transported by dredging equipment. It may have been already present in the ditch before dredging took place, although this cane did not seem to be well established. In any case, the potential danger of mechanical transport is apparent. Concern about this danger is amplified because soil taken from dredged roadsides in the local area, including a portion of roadside immediately adjacent to the obviously infested area, was stockpiled for use as fill for projects where rural bridges are being replaced by large culverts. If Japanese raspberry was present, soil movement in the manner described could rapidly spread it to other sites.

Table 1. Area of Japanese raspberry patches in 2010.

PATCH NUMBER	1	2	3	4	5	6	7	8	9
AREA M^2	48	706	705	96	155	340	179	283	23

Figure 3. Japanese raspberry in a savanna at Neal Smith National Wildlife Refuge in 2010. Photo by Pauline Drobney.

In early July 2010, the savanna site was revisited, and nine Japanese raspberry patches, five of which are in relatively close proximity, provided evidence of substantial expansion of Japanese raspberry (Figure 3).

Using measuring tapes and extrapolation for odd shapes, current coverage by *R. parvifolius* at Neal Smith NWR is roughly estimated at 2,535 square meters. This is a large increase from an estimated 254 square meters known coverage of Japanese raspberry in 1992. In 2010, the largest patch was thriving in a portion of the savanna where all trees had been removed, and it had expanded into an adjacent cornfield. This area had been treated with 7% Garlon 4 (triclopyr) combined with 2% methylated seed oil applied with a backpack sprayer in June 2010. Treatment of the remaining area had not yet been accomplished, impeded by downed trees and excessive rain.

Where the triclopyr application was most effective, canes appeared black with little to no living foliage. Where the Japanese raspberry was growing in full sun, untreated canes were producing large red berries. At the transition between treated and untreated areas, leaf cupping and yellowing typical of herbicide treatment was evident, though the minimally damaged canes will probably recover, and fruits on

these canes sometimes remained bright red and hydrated. Treatment of a cane did not guarantee death of untreated portions, likely because of rooted nodes on the canes within the untreated area. Abundant rain in 2010 may have contributed to an easier recovery than might be expected in times of normal or below average precipitation.

Plant vigor, as well as fruit and flower production of live portions of the population that extended into the woodland, declined with reductions in light. The dense mounds of canes, however, still impeded or excluded growth of native herbaceous vegetation. In areas where visual estimates of woody canopy coverage were 80% to 95%, canes continued to be present, but were much thinner and no flowers or fruits were observed. In these areas, native herbaceous plants were present but also sparse. Widrlechner observed a similar phenomenon when revisiting a woodland population of *R. parvifolius* in Ames, which had been quite vigorous in the late 1980s when the tree canopy was rather open, but which declined considerably as the canopy closed.

The roadside population was also expanding, though it was not yet a mat, and had abundant herbaceous growth of other species interspersed with the canes. Interestingly, by August of 2010, half of the dense population of Japanese raspberry in the roadside had been sprayed by a local landowner targeting small trees. Though the chemical used for this treatment is unknown, the treated portions appeared dead, but canes immediately adjacent to the treatment continued to support live foliage.

Herbicide treatments with glyphosate and triclopyr severely damaged Japanese raspberry, and, with post treatment vigilance for new seedlings and/or plants regenerating from existing crowns or canes, such treatments could control or eliminate these invasive plants. However, "successful" herbicide applications are likely to damage any adjacent or interspersed desirable plants. Although fire management has not been tested as a control for this species, frequent fire treatments in the presence of a sufficient fuel matrix reduce populations of some woodland *Rubus* species, in my experience, and could likewise be useful in controlling *R. parvifolius*. Experimentation is needed to test this possibility. Additionally, if this invasive is found in the context of a savanna restoration project, managers may be wise to consider postponing tree-thinning until Japanese raspberry is controlled or eliminated, as it grows more vigorously in higher light levels. Alternatively, an aggressive program of thinning to promote development of a fuel matrix, careful herbicide treatment of infested areas, and repeated annual burns may also be effective, though again, these ideas are untested.

In conclusion, the presence of *R. parvifolius* has been documented in ten counties in Iowa, and in three other midwestern states. It is likely that additional populations are undetected due to misidentification and lack of awareness. It is a species that spreads rapidly and can tolerate 80% or more shade, though it is more vigorous and healthier at higher light levels, thus posing a greater threat to sparse prairies and open savannas. Plants reproduce vegetatively and produce attractive fruits. Populations can be spread both by land-management equipment and wildlife. In our observations, Japanese raspberry reduces diversity and density, at least in native, open woodlands and roadsides and, if left unchecked, can be difficult to control. More work and study of this species is necessary to discover treatments for effective control while preserving native vegetation on infested sites. We believe that educational programs and websites related to midwestern invasive species should add information about Japanese raspberry to help limit the expansion of this invasive species and educate both land managers and gardeners about its invasive potential.

JAPANESE RASPBERRY (*Rubus parvifolius*) MANAGEMENT WATCH-OUTS

PLANT CHARACTERISTICS

- decumbent, mounding growth habit
- weakly prickly canes
- small rose-pink flowers
- large, bright red fruits (size of commercial raspberries),
- obovate to broadly sub-rhombic central leaflets with obtuse tips
- compound leaves, whitened beneath

HABITAT CHARACTERISTICS

- full sun, partial sun to moderate shade
- semi-xeric to wet-mesic sites (not a wetland plant)

THREAT

- formed near-monoculture excluding other plant species under favorable conditions
- seed dispersed by birds
- ready rooting and spread by nodes on primocanes
- nodes and seed dispersed by equipment

CONTROL

- Current information is scant.
- Effective herbicide treatments need to be tested and documented.
- Some *Rubus* species are reduced with frequent fire, but control of Japanese raspberry using fire is untested.
- Mechanical control is untested but likely to be difficult or ineffective, due to ease of recolonization via crown persistence and nodal rooting.

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